

Occurrences of triatomines (Hemiptera: Reduviidae) and first reports of *Panstrongylus geniculatus* in urban environments in the city of Sao Paulo, Brazil

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ABSTRACT

This note reports on occurrences of triatomine species in the city of Sao Paulo, Brazil, registered between 1988 and 2017. Records of triatomines captured in Sao Paulo are based on specimens received spontaneously from Health Surveillance Centers, Health Centers and Zoonosis Control Centers in the city as well as from citizens. Species were identified morphologically at the Public Health Entomology Laboratory, Faculty of Public Health, University of Sao Paulo, where the triatomines, which are vectors of Chagas disease, were tested for *Trypanosoma cruzi* infection. The first reported occurrence of triatomine bugs in urban Sao Paulo was in 1988. The specimen, which was captured in Jardim Sao Luiz district, was from the genus *Panstrongylus* and was registered as *Panstrongylus* sp. but was not sexed. Since this first recorded occurrence, the following species have been found in the city: *Panstrongylus geniculatus* (2 occurrences), *P. megistus* (15 occurrences), *Triatoma infestans* (1 occurrence) and *T. sordida* (3 occurrences). In this paper, the importance of reporting occurrences of triatomine bugs in the city of Sao Paulo, one of the largest metropolis in the world, is discussed with an emphasis on *P. megistus*. The occurrences discussed here indicate the importance of entomological surveillance for these vectors even in urban centers although the possibility of vector transmission of Chagas disease in these centers is very low.

KEYWORDS: Hemiptera. Reduviidae. Triatominae species. Entomological surveillance. Urban center, *Trypanosoma cruzi*, Chagas disease.

INTRODUCTION

Chagas disease is caused by the protozoan *Trypanozoma cruzi* and is an endemic disease in 21 Latin American countries¹. It is one of 17 diseases classified as neglected tropical diseases by the World Health Organization, and it is estimated that there are around 8 million people worldwide infected by this parasite¹, with Brazil accounting for more than 1.1 million of them². *Trypanosoma cruzi* is naturally transmitted to humans and other mammals through feces and urine eliminated by infected triatomine bugs. Transmission occurs during or shortly after the vector sucks blood from the host, when its feces or urine penetrate the host's skin or mucous membranes³. Other forms of transmission include the oral transmission following ingestion of food contaminated with *T. cruzi*, blood transfusion, organ transplantation from donors with Chagas disease, congenital transmission, breastfeeding and accidental transmission⁴.

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Triatomines are currently distributed in five tribes and 18 genera, totaling 153 recognized species⁵. Of these genera, *Panstrongylus*, *Rhodnius* and *Triatoma* have the most described epidemiologically important species⁶. This note reports on occurrences of triatomine bugs in the municipality of Sao Paulo, SP, Brazil, registered between 1988 and 2017 by the Synanthropic Fauna Identification and Research Laboratory (Labfauna), Zoonosis Surveillance Division, City of Sao Paulo, and the Public Health Entomology Laboratory (LESP), Faculty of Public Health, University of Sao Paulo.

MATERIALS AND METHODS

The records of triatomines captured in the city of Sao Paulo discussed in this note are based on specimens sent spontaneously to Labfauna and LESP by Health Surveillance Centers, Health Centers and Zoonosis Control Centers in the city as well as by citizens.

Morphological species identification and confirmation and, when possible, testing of specimens for *T. cruzi*

infection is normally performed by LESP that keeps records of occurrences of triatomines dating from 1983. The records refer to triatomine bugs in Brazil as well as in other countries.

Labfauna has provided taxonomic identification of synanthropic animals since 1982. The service, which is free, consists of the receiving, taxonomic identification and preservation or disposal of specimens and preparation of technical reports. Specimens received at the laboratory act as sentinels for the presence of species associated with human health risks. Here we discuss only occurrences of triatomines in the municipality of Sao Paulo.

RESULTS

The results are shown in Table 1 in alphabetical order by species and consist of sex, parasitological tests results, district where the specimen came from, corresponding coordinates and year of registration.

Although it was initiated in the years 1982 (Labfauna) and 1983 (LESP), the first occurrence of triatomines

Table 1 - Occurrences of *Triatominae* species in the city of Sao Paulo from 1988 to 2017 recorded by Labfauna and LESP, in chronological order. The following data are shown for each occurrence: sex, result of parasitological examination, district where the specimen was captured, coordinates and year of registration. (N: number of specimens; NS: not sexed; NI: no information)

Taxon	N/Sex	Infect. <i>T. cruzi</i>	District	Coordinates	Year
<i>P. geniculatus</i>	1/NS	NI	Cursino	23°36'10" S 46°37'32" W	1999
<i>P. geniculatus</i>	1/♂	NI	Morumbi	23°35'46" S 46°41'42" W	2014
<i>P. megistus</i>	1/NS	NI	Sacoma	23°38'57" S 46°36'49" W	1996
<i>P. megistus</i>	1/♂	NI	Jabaquara	23°37'33" S 46°38'26" W	1999
<i>P. megistus</i>	1/♂	NI	Jabaquara	23°39'33" S 46°38'48" W	1999
<i>P. megistus</i>	1/NS	NI	Cursino	23°38'30" S 46°36'45" W	2003
<i>P. megistus</i>	1/♂	NI	Cursino	23°37'43" S 46°37'12" W	2003
<i>P. megistus</i>	1/NS	NI	Jaragua	23°27'21" S 46°45'46" W	2004
<i>P. megistus</i>	1/NS	NI	Jardim Angela	23°41'41" S 46°45'30" W	2005
<i>P. megistus</i>	1/NS	NI	Cursino	23°37'50" S 46°36'47" W	2007
<i>P. megistus</i>	1/♂	NI	Jaragua	23°27'50" S 46°45'15" W	2007
<i>P. megistus</i>	1/♀	NI	Jabaquara	23°38'7" S 46°38'39" W	2007
<i>P. megistus</i>	1/♂	Positive	Jabaquara	23°39'18" S 46°38'39" W	2011
<i>P. megistus</i>	1/♂	NI	Pedreira	23°41'51" S 46°37'46" W	2012
<i>P. megistus</i>	1/♀	Negative	Sacoma	23°38'30" S 46°36'45" W	2014
<i>P. megistus</i>	1/♀	NI	Raposo Tavares	23°36'10" S 46°47'43" W	2015
<i>P. megistus</i>	1/♀	NI	Raposo Tavares	23°36'19.31" S 46°47'22" W	2017
<i>Panstrongylus</i> sp.	1/NS	NI	Jardim São Luiz	23°42'23.17" S 46°44'21." W	1988
<i>T. infestans</i>	1/♂	NI	Vila Mariana	23°35'51" S 46°39'65" W	2004
<i>T. sordida</i>	1/♂	NI	Jose Bonifacio	23°32'43.98" S 46°26'17" W	2008
<i>T. sordida</i>	1/♀	NI	Vila Curuça	23°31'42" S 46°23'49" W	2013
<i>T. sordida</i>	1/♀	NI	Vila Prudente	23°35'40" S 46°34'53" W	2017

reported by these laboratories in the city of Sao Paulo was in 1988. The specimen, which was captured in the Jardim Sao Luiz district, was from the genus *Panstrongylus* and was registered as *Panstrongylus* sp. but was not sexed. Since this first occurrence, the following species of triatomine bugs have been found in Sao Paulo: *P. geniculatus* (2 occurrences), *P. megistus* (15 occurrences), *T. infestans* (1 occurrence) and *T. sordida* (3 occurrences). None of the reports indicated domiciliation of the insect. Most of the vectors occurrences in the municipality of Sao Paulo are related to areas in the South of the city that are near remnants of the Atlantic Rainforest (Figure 1). Among the triatomines submitted to parasitological examination, one *P. megistus* specimen, a male captured in the district of Jabaquara, was positive for *T. cruzi*, according to Ribeiro *et al.*⁷.

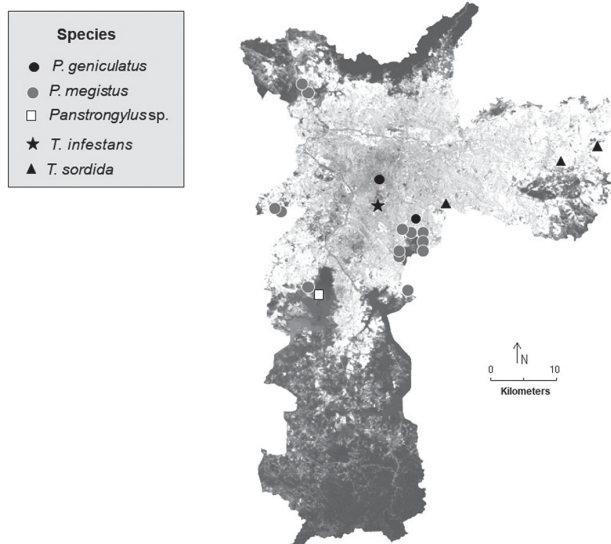


Figure 1 - Occurrences of triatomines in the city of Sao Paulo from 1982 to 2017 recorded by Labfauna and LESP

DISCUSSION

The city of Sao Paulo, one of the largest metropolis in the world with an estimated population of 12 million, the largest in the Southern hemisphere, suffers from severe environmental stress. Because of an extensive human interference in the natural environment, the remaining forest fragments are now found only in parks, gardens and environmental protection areas^{8,9}.

The city of Sao Paulo is located in what was formerly the Atlantic rainforest, an environment with high biodiversity considered one of the 23 “biodiversity hotspots” worldwide¹⁰. Despite the intense expansion of the city in the last five decades, there have been sporadic occurrences of triatomine bugs on the outskirts of Sao Paulo, some in unusual situations^{7,11}.

The only occurrence of *T. infestans* reported in the city of Sao Paulo was in 2004 in the men’s restroom at the Dante Pazzanese Hospital, a national reference center for treatment of Chagas disease. The specimen may have escaped from the triatomine colonies maintained by the hospital for xenodiagnosis. In 2006, Brazil received the international certification for interruption of transmission of Chagas disease by this species from the Pan American Health Organization^{12,13}.

In the State of Sao Paulo, a campaign against the vector of Chagas disease began in 1951^{14,15}. Although *T. infestans* was eliminated from the State by 1990 as a result of the campaign, control activities were not interrupted because of the possibility of sporadic passive reintroduction of *T. infestans* in isolated locations, as reported by Leite *et al.*¹⁴ following the finding of 109 specimens of this species in the municipality of Paulinia, in the State of Sao Paulo, between 1999 and 2000. This was the last reported occurrence of the species in the State.

One reason for continued triatomine surveillance and control activities in the city of Sao Paulo was the presence of species considered important in the transmission of *T. cruzi*, such as *T. sordida* and *P. megistus*, in large areas of Brazil, including the State of Sao Paulo. These species are found colonizing households mainly in annexes and outhouses. Another reason for continued surveillance was the report of invasions of households by *Rhodnius neglectus* in the area of the State corresponding to the Eastern Plateau, Peripheral Depression and Western Plateau and by *Triatoma tibiamaculata* on the State coastline¹⁵.

In the case of *T. sordida*, it is most likely that specimens were taken to the capture locations by passive dispersion as the residents in these locations reported that they had returned from trips to endemic regions. Another possibility is the dispersion by animals, particularly birds, as *T. sordida* feeds preferentially on birds¹⁶. Nymphs and eggs of the species can be dispersed over large areas extending far from the original source of infestation/colonization. The species has a widespread distribution and is found in Argentina, Bolivia, Uruguay and Paraguay and the States of Bahia, Goias, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Parana, Pernambuco, Piaui, Rio Grande do Sul, Santa Catarina and Sao Paulo in Brazil^{17,18}. In Sao Paulo and other States, it is found mainly in *cerrado* (savannah-like grasslands) biomes. It is the most captured vector of Chagas disease, and there have been numerous reports of the species in chicken coops in peridomestic areas with a low *T. cruzi* infection rate^{16,19,20}.

Triatoma sordida populations infected by *T. cruzi* persist even after insecticide has been sprayed because they are autochthonous to the territories where they occur and, after

sheltering in the peridomestic area, can reinfest dwellings once the residual effect of the insecticide has worn off^{16,21}.

Most captures of *P. megistus* in the city of Sao Paulo have been in neighborhoods on the Southern outskirts of the city in areas close to Sao Paulo Zoo, Safari Zoo, the Botanic Gardens and the USP Science and Technology Park, all of which receive large numbers of visitors (Table 1). This suggests that populations of this species remain in forest fragments, where they can perpetuate the *T. cruzi* sylvatic transmission cycle within the boundaries of the municipality of Sao Paulo. In 2016, Ribeiro *et al.*⁷ reported positivity for *T. cruzi* in a *P. megistus* bug captured in an urban area of the city. In a study of epidemiological surveillance in Sao Paulo between 2010 and 2012, Silva *et al.*²⁰ found that this species was the most important vector of Chagas disease in the State, a finding reflected in its increasing domiciliation and high natural-infection index (23.6%).

Panstrongylus geniculatus (Latreille 1811), which has been found naturally infected with *T. cruzi*, has a distribution extending from Southern Mexico to Northern Argentina. Although its habitats include a wide range of biomes and climates^{17,22}, its most common habitat is wild forest environments, where it is found in armadillo (*Dasypodidae*) burrows and opossum (*Didelphis*) dens^{23,24}. Although associated with wild environments, there are reports of the species attacking people²⁴. It has been captured in pigsties and in environments occupied by humans, where it is attracted to light, although without forming colonies in the domicile²³⁻²⁶. Despite the limited vector potential of *P. geniculatus*, this triatomine can be epidemiologically important and has been involved in domestic cycles of *T. cruzi* in Venezuela^{27,28}, Colombia²⁹, Brazil^{23,30-32}, Peru^{33,34}, Bolivia^{35,36} and Argentina³⁷, in the former in an outbreak of Chagas disease due to oral transmission at a school on the outskirts of Caracas^{38,39} and Colombia⁴⁰.

Two occurrences of *P. geniculatus* in the city of Sao Paulo have been reported. The first was of an adult bug found in a neighborhood in the Southern area of the city in 1999, and the second was in July 2014 when a specimen was captured in a *Culex quinquefasciatus* mosquito-breeding facility next to the Pinheiros River (Figure 1). After the specimen had been identified, analysis to detect *T. cruzi* infectivity was conducted according to Ribeiro *et al.*⁷, with negative result. Fifteen days after the specimen was captured, an active search was conducted within a radius of about 250 m of the capture site to locate possible shelters of this triatomine, and five Noireau traps⁴¹ adapted according to Obara *et al.*⁴² were installed. However, none of the procedures resulted in any further captures.

Although the active search for triatomines was negative, the presence of colonies in the area surrounding the breeding

facility cannot be completely ruled out as there are remnants of reforestation and landscaping that provide shelter for rodents and other food sources for triatomines, such as opossums and birds. This species has a wide distribution and could be autochthonous in the area^{17,22}.

Chagas disease is associated with poverty and inadequate sanitation in the dwellings of at-risk populations², and transmission of the disease to humans typically occurs in wild, rural and periurban areas. However, with fragmentation of the natural habitats of the vectors of the disease as a result of urbanization and the increasing use of land for crops and pastures, triatomines, which were previously found exclusively in wild environments, are now commonly found in households, particularly on the outskirts of cities^{39,42,43-45}.

Data on occurrences of triatomines in the city of Sao Paulo indicate the importance of entomological surveillance of these vectors even in urban centers. Although the possibility of vector transmission of Chagas disease in major urban centers is very small, it cannot be ignored. If infected, triatomines that have invaded households and other buildings, to which they are attracted to by various factors, including light, can transmit the etiological agent of Chagas disease to humans and animals. As triatomines can contaminate food and other household items with their urine and feces, it is also important to consider the risk of oral transmission, the main form of transmission of *T. cruzi* today. Examples of this type of transmission have been reported in urban centers in recent decades and include a case involving *T. sordida* in the State of Bahia, Brazil, and another involving *P. geniculatus* in Caracas, Venezuela, in which contaminated water and guava juice, respectively, were ingested^{39,46}. Accidents as a result of handling of the insect by humans or ingestion by domestic animals can also occur in large urban centers, where people are often not familiar with the appearance of these vectors.

These facts imply that in order to prevent the eventual transmission of *T. cruzi* in the municipality of Sao Paulo, the community is encouraged to send any suspicious insects to the local Health Supervisors (SUVIS) and that the communication between the laboratories that participated in this article, together with the Department of Health Coordination Sanitary Surveillance (COVISA) and Superintendence of Control of Endemic Diseases (SUCEN) are further narrowed, allowing a faster flow of specimens for identification and parasitological examinations, as well as more effective sharing of information.

CONFLICT OF INTERESTS

No competing financial conflicts of interest exist.

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